

Diversity and the main ecological requirements of the epigeic species of Carabidae (Coleoptera: Carabidae) from two types of forest ecosystems in Suceava County (Moldavia)

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Abstract

The present paper is a synthetic one dealing with the epigeic ground beetles from the coniferous and beach forests of the Suceava County. It presents the alpha diversity of ground beetles from seven sites (coniferous forest) and one site (beach forest), the variation of the relative abundance of ground beetles, the Shannon index, evenness, and the main ecological requirements of the species, and the general characteristics of the coenoses of ground beetles as concerns the classes of ecological requirements.

Rezumat

Diversitatea și cerințele ecologice principale ale speciilor epigeice de carabide (Coleoptera: Carabidae) din două tipuri de ecosisteme forestiere din județul Suceava

Lucrarea prezentă este o lucrare de sinteză asupra speciilor de carabide epigeice din ecosistemul pădurii de conifere și ecosistemul pădurii de fag din județul Suceava. Pentru colectarea materialului s-a folosit metoda clasică de colectare, câte 12 capcane Barber în fiecare staționar. Materialul s-a colectat din opt staționare, (un staționar din ecosistemul pădurii de fag) în total, șase ani (1977-1979, 1993, 1994, 1998).

Alfa diversitatea a variat între 9 și 24 specii în ecosistemul pădurii de conifere și 16 specii în ecosistemul pădurii de fag, Indicele Shannon a avut valori între 2, 15 și 3, 63 (pădurea de conifere) și 2, 17 (pădurea de fag), echitabilitatea între 60 % și 84 % (pădurea de conifere) și 54 % (pădurea de fag).

Cenozele de carabide din cele două tipuri de ecosisteme, în ce privește principalele cerințe ecologice, se caracterizează prin predominarea speciilor cu reproducere în primăvara, mezofile, cu preferințe pentru biotopul de pădure, zoofage, distribuite preponderent geografic în Palearctic, vest Palearctic, europene, euro-siberiene și carpatice.

Key words: Coniferous forest, beach forest, alpha diversity, relative abundance, Shannon index, evenness, main ecological requirements.

Introduction

Suceava County is located in the northern, North-East extremity of Romania, in the north part of Moldavia, in the upper catchment of the Siret and Bistrița rivers.

The county has an area of 8553 square km, representing 3.6 % of Romania's area, being the second large county of Romania.

The relief is varied: Mountains, plateaus, hills, intramountain and intrahills depressions, valleys etc. The mountain zone covers about two thirds of the county's area. To the East of mountain zone, there is the Suceava Plateau, which covers about one third of the county's area. The Suceava Plateau is divided into two plateaus. The Dragomirna Plateau (altitude 300- 525 m) and the Fălticeni Plateau (altitude 400 - 481m).

The Climate is temperat – continental with a cooler character because of the northern geographical position of the county and of the predominantly mountain relief. Because of the relief and altitude, the annual average temperature of the air varies between 0° and 8° C. 0° C on the high peaks of the mountains; about 2° C in the middle mountains ; 5° C in depressions, and 8° C in the Suceava Plateau.

The annual average amount of precipitations varies altitudinally, from 550 mm in the plateau zone to 800 mm in the subcarpatian hills; and from 1200 mm in the regions of the small and middle –sized mountains to 1400 mm on the high mountains.

Within the ecological conditions of the Suceava county, faunistic research on the curculionids published: (THEODOR & DANILA 1994). Results on the ecological aspects concerning the epigeic

fauna of carabidae in the coniferous forests from Suceava county published: (Varvara 1980); Solomon, Varvara 1983; Varvara and colab. 1997; Varvara 1999).

The purpose of this paper is to present a synthesis on the alpha diversity of epigeic ground beetles, the variation of their relative abundance, the Shannon index and evenness, the degree of similitude between sites and to have a general view on the main ecological requirements, at the level of individuals and coenoses.

Material and methods

The presentation of the work method has to detail the answers for three questions: **Where, when and how.**

Where and when. The material of carabids was collected from two types of forest ecosystems. The coniferous forest and the beach forest.

Out the coniferous forests, the material was collected from 7 sites: Slătioara (1977, 1978, 1979); Suhard (1994); Vatra Dornei Park (1994); Crucea (1994); Dealul Negru (1994); Dorna Arini (1993); Ciocănești (1998).

Out the beach forest, the material was collected from one site, Zvoriștea (1998).

How. As collecting method, the pitfalls were used with preserving liquid and protection from precipitation. 12 pitfalls were used in each site. In this way, the collecting of material had a statistic, objective basis. The pitfalls functioned in ecosystems from may to September included of each year and locality. The collecting of carabids was made once a month. Other details on the collecting method are to be found in our published papers (SOLOMON, VAR-

VARA 1983; VARVARA and colab. 1997).

For the characterization of the carabid coenoses (carabid communities) we have used the following parametres: relative abundance, ecological requirements (time of reproduction, preference for humidity, biotope, food and geographical distribution), Shannon diversity index, evenness, similitude per cent.

Nomenclature of the species was used according to FREUDE, HARDE, LOHSE 1974.

To characterize the coenoses of ground beetles from those two types of forest ecosystems, referring to reproduction, preferences for humidity, biotopes, food regime, geographical distribution, I used my personal observation in the field and information from the literature. (PETRUSENKO 1970), (PETRUSENKO & PETRUSENKO 1972), (TURIN and colab. 1991, 2003), (NECULISEANU 1991, 2003), (ŠUSTEK 2000). I also used some information and verifications received from ŠUSTEK and NECULISEANU 2003.

Results obtained

Relative abundance, Alpha diversity

Our data are expressed in tables 1-7 and histograms 1-6.

The concrete biological system which carry all hierarchical superior taxonomic characters is the individual. Individuals can not live and survive isolatedly, they belong to a population and a population or populations belong to a species.

The species exists through the number of individuals The total abundance of a species is the total number of individuals from a biotope belonging to a species This parameter is an evolutionary

Table 1

Relative abundance of the species of Carabidae in two types of forest ecosystems from Suceava county
1. St. II, Slătioara (1977); 2. St. II Slătioara (1978); 3. St. II, Slătioara (1979); 4. Suhard (1994); 5 Parc Vatra Dornei (1994); 6. Crucea (1994); 7 Dealul Negru (1994); 8 Zvoriștea (1998); 9 Dorna Arini (1993); 10 Ciocănești (1998)

Taxa	1	2	3	4	5	6	7	8	9	10	Total
1 Carabus coriaceus (L.)	18	8	12	71	2	20	-	-	-	-	131
2 C. variolosus (Creutzer)	-	-	-	4	15	-	-	-	3	-	22
3 C. glabratus (Paykull)	-	7	-	40	1	21	2	-	9	8	88
4 C. violaceus (L.)	29	13	15	51	4	1	1	-	3	12	129
5 C. cancellatus (Illig.)	-	-	-	5	-	-	-	6	-	-	11
6 C. intricatus (L.)	-	-	-	5	-	-	-	-	-	-	5
7 C. scabriusculus (Olivier)	-	-	-	-	-	-	-	17	-	-	17
8 C. convexus (F.)	-	-	-	1	-	1	-	-	2	-	4
9 C. linnei (Panzer)	47	140	91	81	-	34	-	-	12	115	520
10 C. irregularis (F.)	20	15	15	-	-	-	-	-	-	-	50
11 C. obsoletus (Sturm)	1	-	-	-	-	-	-	-	-	-	1
12 C. auronitens escheri (Pall.)	64	116	131	9	3	-	-	-	39	19	381
13 Cychrus caraboides (L.)	65	107	133	6	-	1	-	-	1	30	343
14 C. semigranosus (Pall.)	-	-	-	-	-	-	-	-	2	-	2

Taxa	1	2	3	4	5	6	7	8	9	10	Total
15 <i>Nebria gillenhalii</i> (Schön)	-	-	-	-	16	-	2	-	-	-	18
16 <i>Leistus piceus</i> (Frölich)	1	1	4	-	1	-	-	-	-	-	7
17 <i>Notiophilus biguttatus</i> (F.)	1	-	-	-	-	-	-	-	3	-	4
18 <i>Brosicus cephalotes</i> (L.)	-	-	-	-	-	-	-	1	-	-	1
19 <i>Asaphidion flavipes</i> (L.)	-	-	-	-	-	-	-	1	-	-	1
20 <i>Pseudophonus rufipes</i> (De Geer)	-	-	-	-	-	1	-	54	-	-	55
21 <i>Harpalus aeneus</i> (F.)	-	-	-	1	-	-	-	-	-	-	1
22 <i>H. rubripes</i> (Duft.)	-	-	-	-	-	-	-	1	-	-	1
23 <i>H. latus</i> (L.)	-	-	-	-	-	1	-	-	-	-	1
24 <i>H. atenuatus</i> (Stephens)	-	-	-	-	-	-	-	-	4	-	4
25 <i>Poecilus cupreus</i> (L.)	-	-	-	-	-	-	-	30	-	-	30
26 <i>P. versicolor</i> (Sturm)	-	-	-	3	2	1	-	6	-	-	12
27 <i>Pterostichus rufitarsis</i> (Dej.)	1	-	1	-	-	-	-	-	-	-	2
28 <i>Pt. foveolatus</i> (Duft.)	-	-	-	7	19	3	1	-	-	18	48
29 <i>Pt. findeli</i> (Dejean)	396	615	577	5	8	-	-	-	-	-	1601
30 <i>Pt. melanarius</i> (Illiger)	-	-	-	6	22	1	23	240	1	1	294
31 <i>Pt. melas</i> (Creutzer)	-	-	-	-	-	-	-	6	-	-	6
32 <i>Pt. unctulatus</i> (Duft.)	54	16	53	-	2	-	-	-	-	27	152
33 <i>Pt. pilosus</i> (Host)	168	48	71	8	5	-	-	-	-	-	300
34 <i>Pt. niger</i> (Schaller)	-	-	-	36	3	30	5	-	8	-	82
35 <i>Pt. oblongopunctatus</i> (F.)	-	-	-	3	7	4	-	2	7	3	26
36 <i>Pt. jurinei</i> (Panzer)	236	536	425	24	31	-	-	-	2	268	1522
37 <i>Pt. nigrita</i> (Paykull)	-	-	-	-	2	1	3	-	18	-	24
38 <i>Pt. anthracinus</i> (Illiger)	-	-	-	-	1	-	-	-	-	-	1
39 <i>Pt. ovoideus</i> (Sturm)	-	-	-	-	-	-	-	1	-	-	1
40 <i>Molops piceus</i> (Panzer)	10	1	-	2	-	2	-	6	-	1	22
41 <i>Abax schüppeli</i> (Pall.)	-	-	1	-	-	-	-	-	-	-	1
42 <i>A. parallelepipedus</i> (Pill. et Mit.)	17	9	16	24	3	41	-	1	-	-	111
43 <i>A. parallelus</i> (Duft.)	-	-	-	3	-	2	-	2	-	-	7
44 <i>Calathus fuscipes</i> (Goeze)	-	-	-	-	-	-	-	46	1	-	47
45 <i>C. melanocephalus</i> (L.)	-	-	-	-	-	-	-	-	3	-	3
46 <i>Calathus</i> sp.	-	-	-	-	-	-	-	-	-	5	5
47 <i>Platynus assimilis</i> (Payk.)	-	-	-	2	9	-	4	-	-	-	15
48 <i>Amara similata</i> (Gyll.)	-	-	-	1	-	-	3	-	-	-	4
49 <i>A. aulica</i> (Panzer)	-	-	-	-	-	1	-	-	-	-	1
50 <i>Licinus punctatulus</i> (F.)	6	4	2	-	-	-	-	-	-	-	12
51 <i>Dromius agilis</i> (F.)	-	1	-	-	-	-	-	-	-	-	1
Total species	17	16	15	24	20	18	9	16	17	12	
Total individuals	1134	1637	1547	398	156	166	44	420	118	507	6127
% of the total	18.51	26.72	25.25	6.48	2.55	2.71	0.72	6.87	1.93	8.27	100
H	2.83	2.37	2.56	3.55	3.63	2.94	2.34	2.17	3.24	2.15	
Evenness %	69	59	65	77	84	70	73	54	79	60	

result of the intraspecific and interspecific relations (competition, parasitism, predation) and the adaptive potential of species under the influence of the abiotic factors of biotope.

The number of individuals of a species is in correlation with its biomass, the position in the trophic chains of the trophic levels., the position in the zoological scale. The number of individuals of insects is huge because they have a small biomass, and they are parasited and eaten by several kinds of animal groups.

In the scientific reseach of ecology, the notion of relative abundance is used. The relative abun-

dance is the total number of individuals belonging to a species from a biotope, collected by scientific methods.

The relative abundance of epigeic ground beetles is quite variable due to various ecological reasons.

The percentage of species collected to all the collected individuals is the dominance of a species. Ecologically, the dominance of a species expresses the influence of that species in coenosis or biocoenosis by its precentages.

α diversity. In the conditions of the conf-

erous forests from Suceava county (in the North part of Romania), α diversity ranged between 9 species (Dorna Arini, 1993, under anthropic influence) and 24 (Suhard, 1994). In the beach forest from Zvoriștea, the α diversity was represented by 16 species.

Shannon index. The values of the Shannon index within the coniferous forest ranged between 2.15 (Ciocănești, 1998) and 3.63 (Vatra Dornei Park 1994). For the beach forest from Zvoriștea, the Shannon index was 2.17. We mention that the values of this index recorded by us are normal variations of this index, being known that the normal limits of variation of this index are between 1.50 and 3.50.

Evenness Evenness of a coenosis is the measure which shows us how equally the relative abundances of the species are. The value of this index for the coniferous forest of the Suceava county ranged from 50 % (Slătioara 1978) to 84 % (Vatra Dornei Park 1994) and for the beach forest the value was 54 %.

Similarity Index

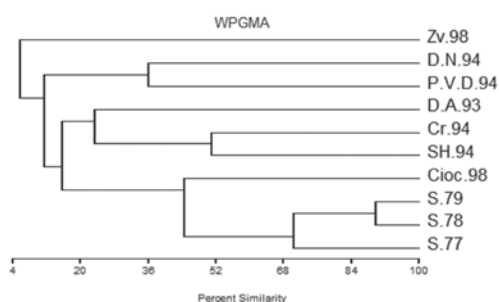


Fig. 1. Hierarchical dendrogram of the sites from which the material of carabids was collected

Legend. S. 77 = Slătioara 1977; S. 78 = Slătioara 1978; S. 79 = Slătioara 1979; SH. 94 = Suhard 1994; P. V. D. 94 = Parcul Vatra Dornei 1994; Cr. 94 = Crucea 1994; D. N. 94 = Dealul Neagru 1994; Zv. 98 = Zvoriștea 1998; DA. 93 = Dorna Arini 1993; Cioc. 98 = Ciocănești 1998

As it can be seen from the dendrogram the beach forest from Zvoriștea is distinctly separated from the other localities with coniferous ecosystem. These localities are divided into three groups. The first group comprises the localities Dealul Negru 1994 and Parcul Vatra Dornei. Between these localities there is a similitude of 35 %. The second group is composed of three localities: Dorna Arini, Crucea and Suhard. Between the localities Crucea and Suhard there is a similitude of 50 %. And between Dorna Arini and Crucea and Suhard there is a similitude of 22 %. The site from Dorna Arini from which the material was collected was under

anthropic influence. The third group is formed by four localities: Ciocănești 1998, Slătioara, 1977, 1978, 1979. The biggest percent similarity (90 %) was between Slătioara 1978, and Slătioara 1979, the material being collected from the same site, but though the material was also collected from the site in 1977, the similitude between the year 1977 and the other two years was 69 %. The altitude of the site from Slătioara was over 1200 m. The similitude between Ciocănești and the site from Slătioara was 43 %. The altitude of the site Ciocănești was about 800 m.

Ecological preferences of the species of Carabidae in the forest ecosystems from Suceava county

To characterize the coenoses of carabids from those two types of forest ecosystems, on the basis of individuals, from the ecological point of view of reproduction, preferences for humidity, biotopes, food regime, geographical distribution, I used my personal observation in the field and information from the literature mentioned above. The results are exposed in table 2.

The synthetic results (number and percentage) referring to these populations parameters are shown

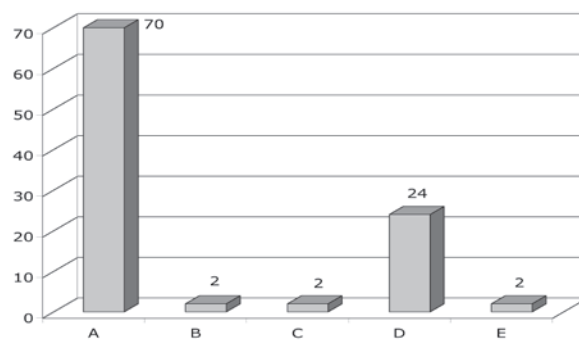


Fig. 2. Percentage representation of the types of reproduction of the carabids in two types of forest ecosystems

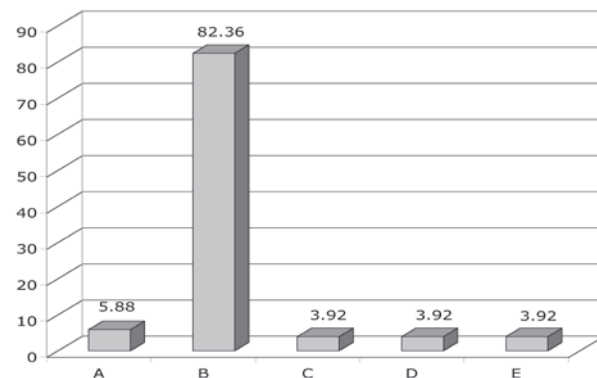


Fig. 3. Percentage representation of the moisture preferences of the carabids in two types of forest ecosystems from Suceava county. (Legend in table 2).

Table 2

Main ecological characteristics of the species of Carabidae from two types of forest ecosystems in Suceava county. Legend: 1 = Reproduction type ; 2 = Humidity preference ; 3 = Biotope preference ; 4 = Food regime ; 5 = Zoogeographical distribution

Sp = Spring; A = Autumnal ; S = Summer ; Pl = Plastic ; M = Mesophilous ; M-H = Mesohygrophilous ; M-X = Mesoxerophilous ; H = Hygrophilous; F = Forest ; St = Steppe ; Eu = Eurytopic ; Cr. = Crops; Z = Zoophagous ; PF = Pantophagous ; Wp = West-palaeartic ; P = Palaeartic ; E = European; Md = Mediterranean; ; Ec = Eurocaucasian ; Es= Eurosiberian ; CE = Central European ; EstE = East- European; SestE = South-East-European; HI = Holarctic, Carp. = Carpathians

	Taxa	1	2	3	4	5
1	<i>Carabus coriaceus</i>	A	M	F	Z	E
2	<i>Carabus variolosus</i>	Sp	H	F	Z	E
3	<i>Carabus violaceus</i>	A	M	F	Z	Wp
4	<i>Carabus cancellatus</i>	Sp	M	F	Z	P
5	<i>Carabus intricatus</i>	Sp	M	F	Z	E
6	<i>Carabus convexus</i>	Sp	M	F	Z	Es
7	<i>Carabus linnaei</i>	S	M	F	Z	CE, estE
8	<i>Carabus irregularis</i>	Sp	M	F	Z	E
9	<i>Carabus glabratus</i>	A	M	F	Z	Es
10	<i>Carabus scabriusculus</i>	Sp	M	Cr, St	Z	E
11	<i>Carabus obsoletus</i>	Sp	M	F	Z	Carp
12	<i>C. auronitens escheri</i>	Sp	M	F	Z	Carp.
13	<i>Cychrus caraboides</i>	Sp	M	F	Z	E
14	<i>Cychrus semigranosus</i>	Sp	M	F	Z	SestE
15	<i>Nebria gillenhalii</i>	A	M	F	Z	HI
16	<i>Leistus piceus</i>	A	M	F	Z	E
17	<i>Notiophilus biguttatus</i>	Sp	M	Eu	Z	Es
18	<i>Brosicus cephalotes</i>	Sp	X	Cr, St.	Z	E
19	<i>Asaphidion flavipes</i>	Sp	M-H	F	Z	Wp
20	<i>Pseudophonus rufipes</i>	A	M	Cr	PF	Wp
21	<i>Harpalus aeneus</i>	Sp	M-X	Cr	PF	P
22	<i>Harpalusa rubripes</i>	A	X	F	PF	Wp
23	<i>Harpalus latus</i>	A	M	F, St	PF	P
24	<i>Harpalus tenuatus</i>	A	M	F	PF	Wp
25	<i>Poecilus cupreus</i>	Sp	M	Cr	Z	Es
26	<i>Poecilus versicolor</i>	Sp	M	Cr	Z	P
27	<i>Pterostichus rufitarsis</i>	Sp	M	F	Z	Carp
28	<i>Pterostichus foveolatus</i>	Sp	M	F	Z	Carp
29	<i>Pterostichus findeli</i>	Sp	M	F	Z	Carp
30	<i>Pterostichus melanarius</i>	Sp	M	F, Cr	Z	Es
31	<i>Pterostichus melas</i>	Sp	M-X	F	Z	Ec
32	<i>Pterostichus unctulatus</i>	Sp	M	F	Z	E
33	<i>Pterostichus pilosus</i>	Sp	M	F	Z	CE
34	<i>Pterostichus niger</i>	Pl	M	Eu	Z	P
35	<i>Pt. oblongopunctatus</i>	Sp	M	F	Z	P
36	<i>Pterostichus jurinei</i>	Sp	M	F	Z	Carp
37	<i>Pterostichus nigrita</i>	Sp	H	F	Z	P
38	<i>Pt. anthracinus</i>	Sp	H	F	Z	Es
39	<i>Pterostichus ovoideus</i>	Sp	M	F	Z	Ec
40	<i>Molops piceus</i>	Sp	M	F	Z	E
41	<i>Licinus punctatulus</i>	A	M	Eu	Z	Wp
42	<i>Abax schüppeli</i>	Sp	M	F	Z	E
43	<i>Abax parallelepipedus</i>	Sp	M	F	Z	E
44	<i>Abax parallelus</i>	A	M	F	Z	E
45	<i>Calathus fuscipes</i>	A	M	Eu	PF	Wp
46	<i>C. melanocephalus</i>	Sp. A	M	Eu	PF	P
47	<i>Calathus sp.</i>		M			
48	<i>Platynus assimilis</i>	Sp	M-H	F	Z	P
49	<i>Dromius agilis</i>	Sp	M	F	Z	Es
50	<i>Amara similata</i>	Sp	M	F, St	PF	P

	Taxa	1	2	3	4	5
51	Amara aulica	Sp	M	Cr	PF	Wp

Table 3

Types of reproduction of the carabids in two types of forest ecosystems from Suceava county

Legend: A. Spring; B. Autumnal –Spring; C. Summer ; D. Autumnal ; E. Plastic; F = Total species

	A	B	C	D	E	F
No of species	35	1	1	12	1	50
% of total	70	2	2	24	2	100

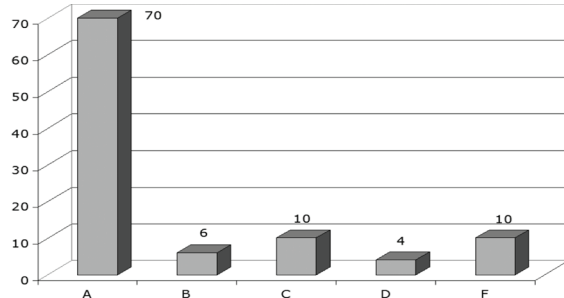


Fig. 4. Percentage representation of the general biotope preferences of the species of carabids in two types of forest ecosystems from Suceava county (legend in table 3)

Table 4

General moisture preferences of the species of carabids in two types of forest ecosystems from Suceava county.

Legend: A. Hygrophilous; B. Mesophilous ; C. Meso-hygrophilous; D. Meso-xerophilous; E, Xerophilous; F =Total species

	A	B	C	D	E	F
No of species	3	42	2	2	2	51
% of total	5.88	82.36	3.92	3.92	3.92	100.00

Table 5

General biotope preferences of the species of carabids in two types of forest ecosystems from Suceava county.

Legend: A. Forest; B. Forest, steppe; C. Crops; D. Crops, Steppe; E. Eurytopic ; F = Total species

	A	B	C	D	E	F
No of species	35	3	5	2	5	50
% of total	70.00	6.00	10.00	4.00	10.00	100.00

Table 6

General trophic regime of the species of carabids in two types of forest ecosystems from Suceava county.

Legend: A. Zoophags; B. Pantophags; C Total species

	A	B	C
No of species	41	9	50
% of total	82.00	18.00	100.00

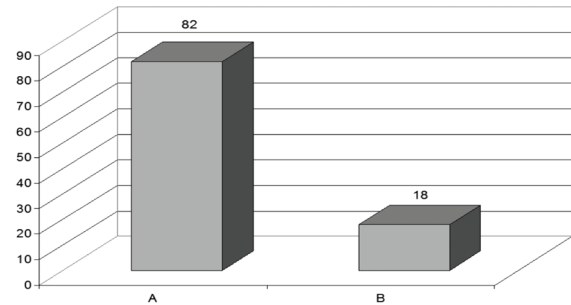


Fig. 5. Percentage representation of the general trophic regime of the species of carabids in two types of forest ecosystems from Suceava county (Legend in table 6)

Table 7

General geographical distribution of the species of carabids in two types of forest ecosystems from Suceava county

Legend: A. Palearctic; B. West Palearctic ; C. Holarctic; D. European; E. Central-European; F. Central, East-European ; G. Eurosibirian; H. Eurocaucasian; I. South-East-European ; J. Carpathian; K. Total species

	A	B	C	D	E	F	G	H	I	J	K
No of species	11	7	1	12	1	1	7	2	1	7	50
% of total	22	14	2	24	2	2	14	4	2	14	100

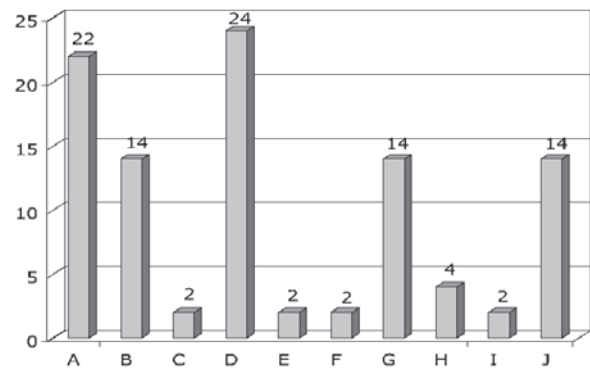


Fig. 6. Percentage representation of the general geographical distribution of the species of carabids in two types of forest ecosystems from Suceava county (Legend in table 7).

Discussions

Our results show that the number of species, the number of specimens, the Shannon diversity index, echitableness present local variations as a result of the concrete ecological determinism.

Annual and local variations of the number of species (alfa diversity) in the coniferous ecosystem from 9 localities of Suceava county was between 9 species (Dealul Negru, 1994) and 24 species (Suhard, 1994). For the beach ecosystem (Zvoriștea, 1998), the alpha diversity was formed by 16 species. There is a close connection between ecodiversity and biodiversity, according to biocoenotic principles of THIENEMANN; in our case between the local conditions of the ecosystems and the alpha diversity

of carabids. As for instance, in the Nature Reserve of Slătioara, in the same site of the material collecting, for three years running (1977-1979), the alpha diversity varied between 15 and 17 species, 13 species being collected commonly in each year

According to THIENEMANN's principles, between ecodiversity and biodiversity the correlation is positive, but between the number of species and the number of individuals the correlation is negative: Few species with many individuals (dominant and eudominant species), and many species with few individuals: subrecent (subsporadic) and recent (sporadic) species.

In the Nature Reserve of Slătioara at the altitude of over 1200 m, the following species are well represented at the level of individuals: *Carabus linnei*, *C. auronitens escheri*, *Cychrus caraboides*, *Pterostichus findeli*, *Pt. pilosus*, *Pt. jurinei*. But the same species in the other six localities (table 1) had few individuals or they were not collected. The Nature Reserve is protected by law and the conditions remain relatively undisturbed.

The synthetic relations between the number of species and the number of individuals (total and for each species) are made evident by the Shannon index. (Table 1)

Normally, the values of this index varies between 1.50 and 3.50. The lowest value of the Shannon index in those two types of forests from Suceava county was 2.15 in the coniferous forest of Ciocănești (1998) and the highest value of 3.63 in the coniferous Park of Vatra Dornei. As it is known the value of this index is influenced by the number of species and by their evenness. For instance, in our data, in the locality of Ciocănești there were collected 12 species, evenness 60 %, and in the Park of Vatra Dornei there were collected 20 species with an evenness of 84 % (Table 1).

In open biotopes, specific diversity is higher than in forests, but the number of individuals and their fluctuation is higher in forests (MOUSSON & LEBRUN 1996). These variations are a synthetic result of the action of abiotic factors which have effect in the ecological context in unity with ecological valences of species: Soil type, the content in humus, temperature and soil humidity variation, the pH, vegetation character and the shade degree of soil (HURCA, ŠUSTEK 1995, ŠUSTEK 2000, ŠUSTEK 2001, NECULISEANU 1995, HOLLAND & LUFF 2000, VARVARA & SOARE 2003).

The preference of species of carabidae for biotope and habitat is expressed by the number of individuals (TURIN and colab. 1991, p. 283). Mesohygrophilous species as for instance, *Carabus arvensis*, *Cychrus semigranosus*, *Leistus piceus*, *Pter-*

ostichus oblongopunctatus, *Platynus assimilis* had a higher number of individuals in the Carpino-Tilio-Făgetum association. (VARVARA 2004)

As for the reproduction seasons of carabids in the forest ecosystems from Suceava county, two groups are dominant. Spring species (35 species, 70 %) and autumnal species (12 species, 24 %) (Table 3, Fig. 2). It is a general conclusion for the deciduous and coniferous ecosystems from Moldavia that the spring species are dominant in variable proportion according to local conditions, followed by the autumnal species, as for instance, in the deciduous forest of Bârnova (Iași county) 69.4 % of species were spring species and 22.5 % were autumnal species. (VARVARA 2004). The proportions of the reproductive classes in a coenosis of carabids is an ecological and evolutionary result connected with temperature, food, competition.

Temperature and moisture are the main variable physical (ecological) factors of the environment influencing the activity and distribution of ground beetles in their biotope and habitats. We use here the term of habitat in the sense of a fragment of a biotope with similar conditions.

As for the humidity, we classified the species into five groups. *Hygrophilous*, *mesophilous*, *mesohygrophilous*, *mesoxerophilous* and *xerophilous* species. The preference of the individuals of a species for a particular range of an environmental factor is according to their preferendum. The preferendum limits the distribution of individuals to biotope or habitat. From our results, 29 species (58.0 %) are mesophylous, 9 species (18.0 %) are mesoxerophilous and 6 species are mesohygrophilous species (table 4, Fig. 3).

The species *Carabus variolosus* is a hygrophilous one. As one can see from table 1, the species was found only in two localities, Suhard and the Vatra Dornei Park, because, in the other sites, there were no running or stagnant water in the neighbourhood of the pitfalls.

Referring to preferred biotopes (table 5, Fig. 4), 35 species (66 %) are forest species, 5 species (10 %) are crop species and other 5 species (10 %) are eurytopic species. Therefore in the forests from Suceava district more than sixty per cent of the species are forest species, as in other deciduous forests from Moldavia, for example, in the Bârnova deciduous forest, 66 % of the species of ground beetles are forest species. (VARVARA 2004)

As expected, the food regime of the species of carabids in the Suceava forests is predominantly zoophagous, that is 41 species (82.0 %) and only 9 species (18.0 %) are pantophagous. (table 6, Fig. 5). Predation is primarily of insects on the soil surface.

As concerns the geographical distribution of the species of carabids found in the Suceava forest, the results are shown in table 7 and in Fig. 6. 12 species (24 %) are European species, 11 species (22 %) are Palaearctic species. The West Palaearctic, Carpathian and Eurosibirian species represent each seven species, that is 14 % of the whole assemblage. So from those said above, we can characterize the species occurring in the Suceava forests as being mostly spring, mesophilous, forest, European, Palaearctic, west Palaearctic and Eurosibirian species what is true for other deciduous forests from Moldavia.

Theoretically, the epigeic fauna of ground beetles in those two types of forests must be richer if the method of hand collecting is also applied.

Conclusions

Alpha diversity of epigeic ground beetles in Suceava county varies between 9 and 24 species in the coniferous forests and 17 species in the beach forest.

The Shannon index had values between 2. 15 and 3. 63 in the coniferous forests and 2. 17 in the beach forest.

70 % of the species have their reproduction in Spring and are forest species and 24 % are species reproducing in Autumn

82 % of the species are mesophilous and zoophagous species.

24 % of the species are European species, 22 % are Palaearctic species. The West Palaearctic, Eurosibirian and Carpathian species have a percentage of 14 % each.

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